National Institute of Environmental Health Sciences

Sensitivity of US air quality to mid-latitude cyclone frequency and implications of 1980-2006 climate change

Author(s): Leibensperger EM, Mickley LJ, Jacob DJ
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Abstract:

We show that the frequency of summertime mid-latitude cyclones tracking across eastern North America at 40°-50° N (the southern climatological storm track) is a strong predictor of stagnation and ozone pollution days in the eastern US. The NCEP/NCAR Reanalysis, going back to 1948, shows a significant long-term decline in the number of summertime mid-latitude cyclones in that track starting in 1980 (-0.15 a-1). The more recent but shorter NCEP/DOE Reanalysis (1979-2006) shows similar interannual variability in cyclone frequency but no significant long-term trend. Analysis of NOAA daily weather maps for 1980-2006 supports the trend detected in the NCEP/NCAR Reanalysis 1. A GISS general circulation model (GCM) simulation including historical forcing by greenhouse gases reproduces this decreasing cyclone trend starting in 1980. Such a long-term decrease in mid-latitude cyclone frequency over the 1980-2006 period may have offset by half the ozone air quality gains in the northeastern US from reductions in anthropogenic emissions. We find that if mid-latitude cyclone frequency had not declined, the northeastern US would have been largely compliant with the ozone air quality standard by 2001. Mid-latitude cyclone frequency is expected to decrease further over the coming decades in response to greenhouse warming and this will necessitate deeper emission reductions to achieve a given air quality goal.

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Resource Description

Exposure : M

weather or climate related pathway by which climate change affects health

Air Pollution, Extreme Weather Event

Air Pollution: Ozone

Extreme Weather Event: Hurricanes/Cyclones

Geographic Feature: M

resource focuses on specific type of geography

None or Unspecified

Geographic Location: M

resource focuses on specific location

United States

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content